

## OLD MOUTH OF COWLITZ RIVER SEDIMENT EVALUATION

Abstract

Based on current and previous studies and according to CENPP Tiered Testing Guidelines, sediment from the Federal project at the old mouth of the Cowlitz River is acceptable for unconfined in-water disposal.

Introduction

1. The old mouth of the Cowlitz River is located at approximately Columbia River mile 67.7, on the Washington side of the river, just upstream from the town of Longview. The existing project provides for a channel 8 feet deep and 100 feet wide from deep water in the Columbia River to old river mile 0.7. Sediment from the Cowlitz River, Carrols channel and the main channel of the Columbia River undoubtedly contributes to shoaling of the old mouth of the Cowlitz. Usually sediment is dredged from the old mouth channel by agitation. The sediment is then washed downstream by river current.

2. Past studies of the sediment in the channel of the old mouth of the Cowlitz show that it changes from medium sand at the mouth to medium silt at the end of the channel at RM 0.7. Volatile solids, a measure of organic content, follows a similar pattern progressing from 0.3 percent to 2.2 percent. Nearby sediments, in the main channel of the Columbia River, are medium to coarse sands and volatile solids are always less than 1.0 percent. Sediments from the old mouth of the Cowlitz have traditionally been disposed in-water via agitation dredging whereby the prop of the dredge agitates sediment from the bottom and the sediment is then washed downstream by the river current.

3. Some of the sediment samples collected were subjected to chemical analysis because project sediments are near industrial and port activities and, according to our database records, no prior chemical data existed for sediments at this location.

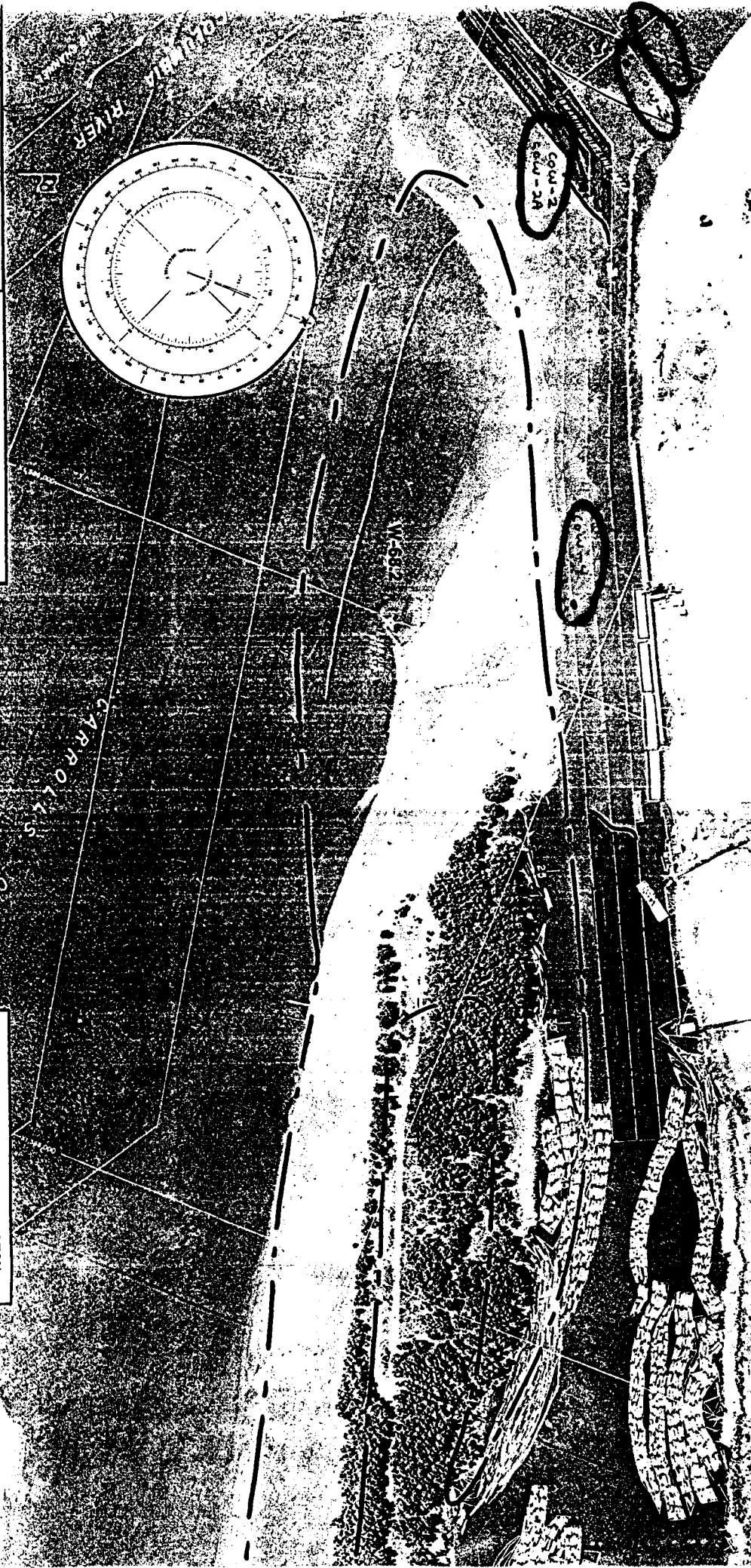
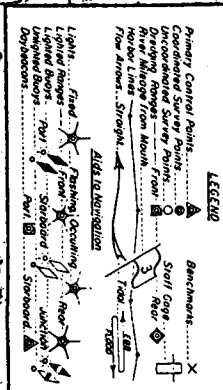
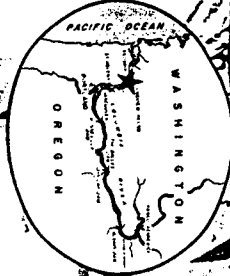
Methods

4. Sediment samples were collected on 15 January 1991 from shoal areas in the project channel in the old mouth of the Cowlitz River (see map). Five samples were taken by vibra-core. Samples Cow-1, and 3 were taken from shoal at the mouth of the old Cowlitz but slightly downstream from the project. Samples were taken at those two locations because this is an area where some of the agitated sediments from the project will settle and it is likely that this area also will be agitated to make way for project sediments as they move downstream in the water current. Samples Cow-2, 2A and 4 were taken from shoals in the project channel at RM 0.0 and 0.3. Cores were of adequate length to sample the dredging prism. Each core was sub-sampled along its entire length for both physical and chemical tests. Physical testing included measures of grain size distribution and percent volatile solids. Chemical tests were run on four samples. The chemical samples were handled according to standard EPA/USACE methods. Chemical samples were stored in acid rinsed, glass jars topped with teflon lined lids. They were cold stored in an ice chest and delivered immediately to Columbia Analytical Services in Kelso, Washington. Metals, polyaromatic hydrocarbons (PAH's), pesticides, PCB's, and phenols were measured.

Results/discussion

5. Results of physical and chemical tests are presented in Tables 1 and 2. Raw data are appended to this report. The mean median grain size for all the samples was 0.140 mm which is in the range of fine sand. One sample, Cow-4 with the largest median grain size, also showed the widest range of grain sizes from pebbles to silt. There appeared to be pumice pebbles in this sample. In fact, most of the samples contained what appeared to be Mt. St. Helens material. Fines ranged from 8.1 to 21.2 percent (mean = 14.3 %). The mean volatile solids content was 0.8 percent. These physical parameters

#	<u>detection limits</u>
Pesticides	1-30 ppb
Phenols	20-50
PAHs	20-40
PCBs	10

[illegible]

The information depicted on this map represents the results of surveys made on the debris indicators and can only be compared as indicating the general condition existing at that time.

The information depicted on this map represents the results of surveys made on the dates indicated and can only be considered as indicating the general condition existing at that time.





DEPARTMENT OF THE ARMY  
NORTH PACIFIC DIVISION MATERIALS LABORATORY  
CORPS OF ENGINEERS  
1491 N.W. GRAHAM AVENUE  
TROUTDALE, OREGON 97060-9503

CENPD-PE-GT-L (1110-1-8100c)

5 Feb 91

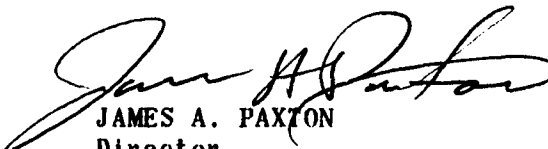
MEMORANDUM FOR Commander, Portland District, ATTN: CENPP-PE-HR

SUBJECT: W.O.#91-SM-342, Report of Tests on Sediment Samples

Project: MOUTH OF THE COWLITZ RIVER  
Intended Use: Dredging projects  
Source of Material: Cowlitz River mouth - old channel  
Submitted by: CENPP-PE-HR (Britton)  
Date Sampled: 15 Dec 90 Date Received: 16 Jan 91  
Method of Test or Specification: ASTM, EM1110-2-1906  
Reference: a) DD Form 448, MIPR No. E86-91-0056, dated 25 Jan 91  
b) NPD Form 303, Sample Transmittal, dated 16 Jan 91, covering the samples tested.  
c) Advance report (FAX), dated 18 Jan 91

1. Enclosed, confirming FAX report, are six Gradation Analysis summary sheets with hydrometer and volatile solids results for each sample.
2. Chemical analysis of these samples are underway; results will be reported as available.

Enclosures

  
JAMES A. PAXTON  
Director

Copy Furnished: CENPD-PE-GT

MOUTH OF THE COWLITZ RIVER (91-SM-342)

Boring: -- Sample: COW-1 Depth: -- Lab No.: 34201

----- Sieve Analysis -----

Sieve	Cumulative Grams Retained	Percent Passing
5 In.	0.00	100.0
2.5 In.	0.00	100.0
1.25 In.	0.00	100.0
5/8 In.	0.00	100.0
5/16 In.	0.00	100.0
No. 5	0.00	100.0
No. 10	0.00	100.0
Pan	113.00	0.0
No. 18	0.00	100.0
No. 35	0.10	99.9
No. 60	3.10	97.3
No. 120	62.80	44.4
No. 230	103.90	8.1
Pan	113.00	0.0

----- Hydrometer Analysis -----

Sample Weight: 113. gr.	Start Time: 0000			
Time	Temp (C)	Hydrometer Reading	Diameter in mm	Percent Finer
1	20.0	7.4	0.0520	6.9
3	20.0	4.9	0.0305	4.7
10	20.0	3.4	0.0168	3.4
100	20.0	1.9	0.0069	2.1
200	20.0	1.2	0.0049	1.5

D85: 0.21 D60: 0.15 D50: 0.13 D30: 0.10 D15: .076 D10: .067 mm

Cu: 2.24 Cc: 1.03

Gravel: 0.0%

Sand: 85.8%

Fines: 14.2%

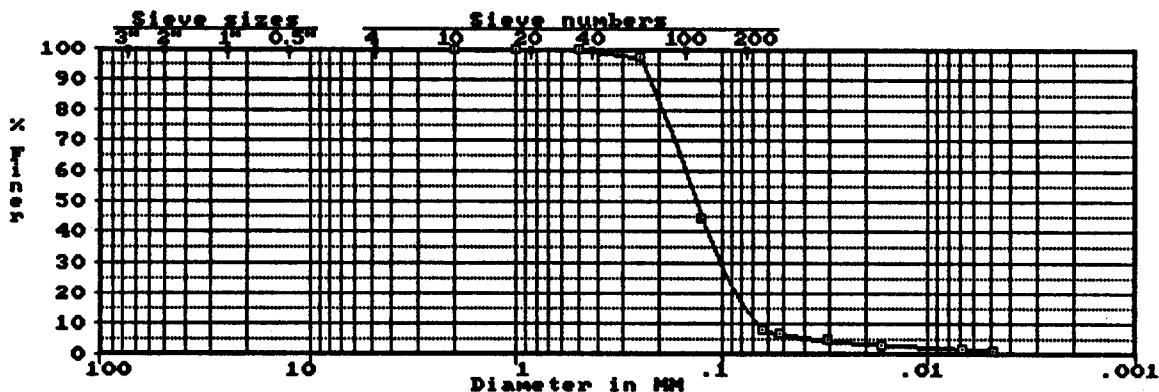
----- Comments -----

- SAMPLED FROM MOUTH OF THE OLD CHANNEL

- SAMPLED ON 15 DEC 90

- VOLATILE SOLIDS = 0.7%

Cannot classify soil without knowing type of fines.



\*\*\* Corps of Engineers - North Pacific Division Materials Laboratory \*\*\*

MOUTH OF THE COWLITZ RIVER (91-SM-342)

Boring: -- Sample: COW-2 Depth: -- Lab No.: 34202

Sieve Analysis			Hydrometer Analysis				
Cumulative			Sample Weight: 105.7 gr. Start Time: 0000				
Sieve	Grams Retained	Percent Passing	Time	Temp (C)	Hydrometer Reading	Diameter in mm	Percent Finer
5 In.	0.00	100.0	1	20.0	17.9	0.0490	17.2
2.5 In.	0.00	100.0	3	20.0	10.9	0.0295	10.7
1.25 In.	0.00	100.0	10	20.0	6.9	0.0165	6.9
5/8 In.	0.00	100.0	100	20.0	2.9	0.0069	3.2
5/16 In.	0.00	100.0	200	20.0	2.2	0.0049	2.5
No. 5	0.00	100.0					
No. 10	0.00	100.0					
Pan	105.70	0.0					
No. 18	0.00	100.0					
No. 35	0.20	99.8					
No. 60	2.50	97.6					
No. 120	39.00	63.1					
No. 230	83.30	21.2					
Pan	105.70	0.0					

D85: 0.18 D60: 0.12 D50: 0.10 D30: .075 D15: .042 D10: .027 mm

Cu: 4.42 Cc: 1.73

Gravel: 0.0%

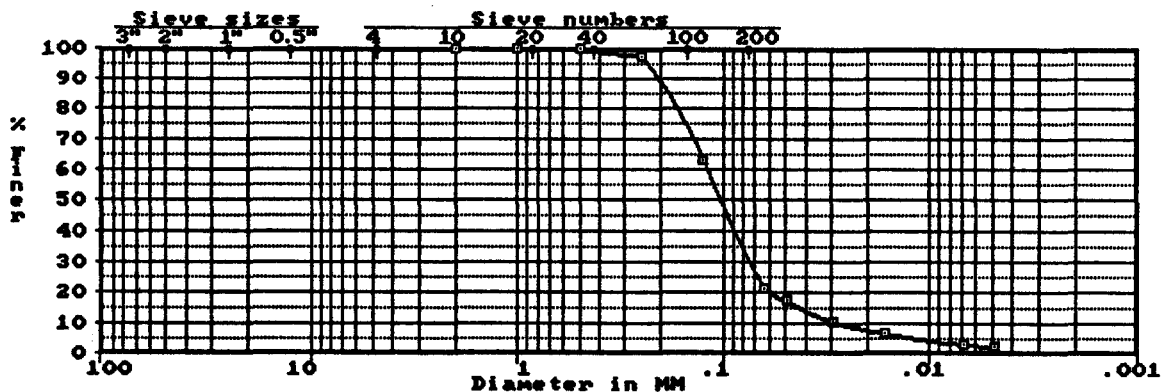
Sand: 69.9%

Fines: 30.1%

Comments

- SAMPLED FROM MOUTH OF THE OLD CHANNEL
- SAMPLED ON 15 DEC 90
- VOLATILE SOLIDS - 1.3%

Cannot classify soil without knowing type of fines.



\* \* \* Corps of Engineers - North Pacific Division Materials Laboratory \* \* \*

MOUTH OF THE COWLITZ RIVER (91-SM-342)

Boring: -- Sample: COW-2A Depth: -- Lab No.: 34203

----- Sieve Analysis -----

Sieve	Cumulative Grams Retained	Percent Passing
5 In.	0.00	100.0
2.5 In.	0.00	100.0
1.25 In.	0.00	100.0
5/8 In.	0.00	100.0
5/16 In.	0.00	100.0
No. 5	0.00	100.0
No. 10	0.00	100.0
Pan	90.70	0.0
No. 18	0.00	100.0
No. 35	0.20	99.8
No. 60	6.40	92.9
No. 120	26.50	70.8
No. 230	73.00	19.5
Pan	90.70	0.0

----- Hydrometer Analysis -----

Time	Temp (C)	Hydrometer Reading	Diameter in mm	Percent Finer
1	20.0	12.9	0.0505	14.6
3	20.0	7.9	0.0300	9.2
10	20.0	4.4	0.0167	5.3
100	20.0	0.9	0.0070	1.5
200	20.0	0.7	0.0049	1.3

D85: 0.18 D60: 0.11 D50: .097 D30: .074 D15: .052 D10: .034 mm

Cu: 3.24 Cc: 1.46

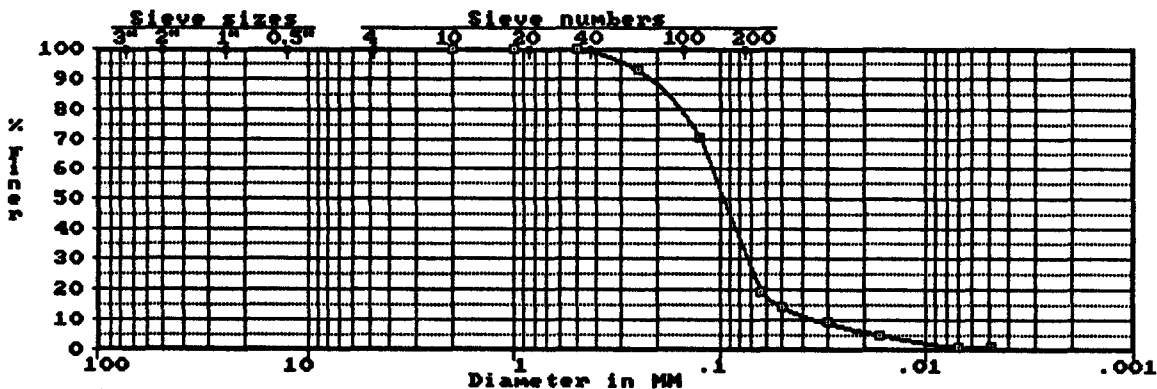
Gravel: 0.0%

Sand: 68.6%

Fines: 31.4%

----- Comments -----

- SAMPLED FROM THE MOUTH OF THE OLD CHANNEL
  - SAMPLED ON 15 DEC 90
  - VOLATILE SOLIDS - 0.8%
- Cannot classify soil without knowing type of fines.



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MOUTH OF THE COWLITZ RIVER (91-SM-342)

Boring: -- Sample: COW-3 TOP Depth: -- Lab No.: 34204

----- Sieve Analysis -----

Sieve	Grams Retained	Percent Passing
5 In.	0.00	100.0
2.5 In.	0.00	100.0
1.25 In.	0.00	100.0
5/8 In.	0.00	100.0
5/16 In.	0.00	100.0
No. 5	0.00	100.0
No. 10	0.00	100.0
Pan	103.30	0.0
No. 18	0.00	100.0
No. 35	0.20	99.8
No. 60	2.70	97.4
No. 120	57.80	44.0
No. 230	95.60	7.5
Pan	103.30	0.0

----- Hydrometer Analysis -----

Sample Weight: 103.3 gr.	Start Time: 0000			
Temp (C)	Hydrometer Reading	Diameter in mm	Percent Finer	
1	20.0	5.9	0.0525	6.1
3	20.0	3.9	0.0306	4.2
10	20.0	3.2	0.0168	3.5
100	20.0	0.9	0.0070	1.3
200	20.0	0.7	0.0049	1.2

D85: 0.21 D60: 0.15 D50: 0.13 D30: 0.10 D15: .077 D10: .068 mm

Cu: 2.21 Cc: 1.02

Gravel: 0.0%

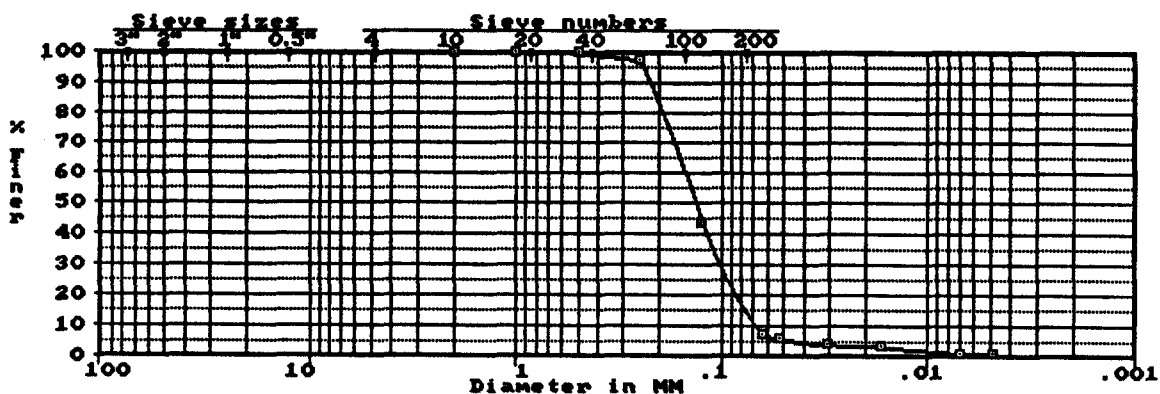
Sand: 86.3%

Fines: 13.7%

----- Comments -----

- SAMPLED FROM MOUTH OF THE OLD CHANNEL
- SAMPLED ON 15 DEC 90
- VOLATILE SOLIDS = 0.6%

Cannot classify soil without knowing type of fines.



\*\*\* Corps of Engineers - North Pacific Division Materials Laboratory \*\*\*

MOUTH OF THE COWLITZ RIVER (91-SM-342)

Boring: -- Sample: COW-3 BOT. Depth: -- Lab No.: 34205

Sieve Analysis			Hydrometer Analysis				
Cumulative			Sample Weight: 115. gr.		Start Time: 0000		
Sieve	Grams Retained	Percent Passing	Time	Temp (C)	Hydrometer Reading	Diameter in mm	Percent Finer
5 In.	0.00	100.0	1	20.0	8.4	0.0518	7.7
2.5 In.	0.00	100.0	3	20.0	4.9	0.0305	4.6
1.25 In.	0.00	100.0	10	20.0	3.4	0.0168	3.4
5/8 In.	0.00	100.0	100	20.0	0.9	0.0070	1.2
5/16 In.	0.00	100.0	200	20.0	0.7	0.0049	1.0
No. 5	0.00	100.0					
No. 10	0.00	100.0					
Pan	115.00	0.0					
No. 18	0.00	100.0					
No. 35	0.20	99.8					
No. 60	3.40	97.0					
No. 120	62.30	45.8					
No. 230	103.10	10.3					
Pan	115.00	0.0					

D85: 0.21 D60: 0.15 D50: 0.13 D30: .098 D15: .072 D10: .062 mm

Cu: 2.39 Cc: 1.05

Gravel: 0.0%

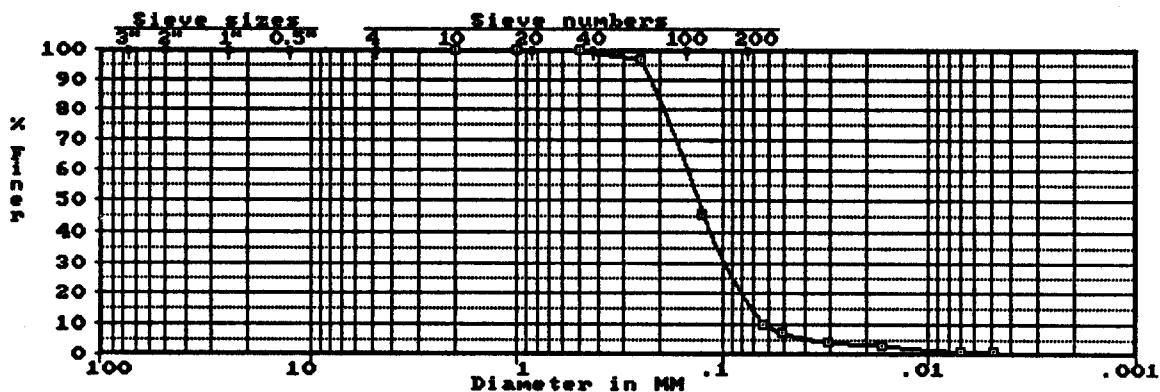
Sand: 83.3%

Fines: 16.7%

Comments

- SAMPLED FROM MOUTH OF THE OLD CHANNEL
- SAMPLED ON 15 DEC 90
- VOLATILE SOLIDS = 0.7%

Cannot classify soil without knowing type of fines.



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MOUTH OF THE COWLITZ RIVER (91-SM-342)

Boring: -- Sample: COW-4 Depth: -- Lab No.: 34206

----- Sieve Analysis -----

Sieve	Cumulative Grams Retained	Percent Passing
5 In.	0.00	100.0
2.5 In.	0.00	100.0
1.25 In.	0.00	100.0
5/8 In.	3.80	99.8
5/16 In.	13.60	99.4
No. 5	38.90	98.1
No. 10	84.50	96.0
Pan	2097.60	0.0
No. 18	4.00	91.4
No. 35	19.00	74.4
No. 60	40.50	49.9
No. 120	54.10	34.5
No. 230	67.50	19.2
Pan	84.40	0.0

----- Hydrometer Analysis -----

Sample Weight: 84.4 gr.		Start Time: 0000		
Time	Temp (C)	Hydrometer Reading	Diameter in mm	Percent Finer
1	20.0	13.9	0.0502	16.2
3	20.0	9.9	0.0296	11.7
10	20.0	5.9	0.0166	7.2
100	20.0	1.4	0.0069	2.1
200	20.0	0.7	0.0049	1.4

D85: 0.73 D60: 0.33 D50: 0.25 D30: 0.10 D15: .044 D10: .024 mm

Cu: 13.9 Cc: 1.36

Gravel: 1.5%

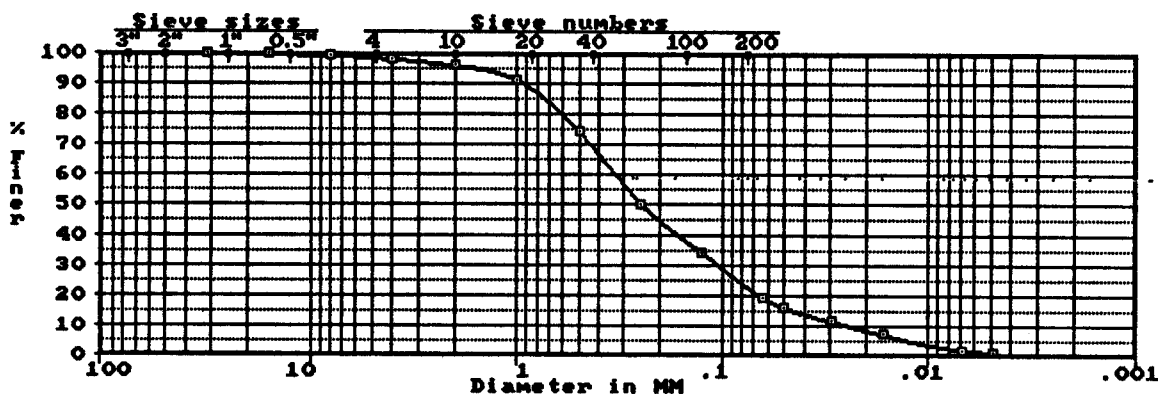
Sand: 75.9%

Fines: 22.7%

----- Comments -----

- SAMPLED FROM MOUTH OF THE OLD CHANNEL
- SAMPLED ON 15 DEC 90
- VOLATILE SOLIDS = 0.7%

Cannot classify soil without knowing type of fines.



## COLUMBIA ANALYTICAL SERVICES, INC.

## Analytical Report

Client: U.S. Army Corps of Engineers  
 Submitted By: Mr. Jim Paxton  
 Project: Mouth of Cowlitz  
 Sample Matrix: Sediment

Date Received: 01/15/91  
 Work Order #: K910238

Total Metals  
 mg/Kg (ppm)  
 Dry Weight Basis

Analytes	Method	MRL	Sample Name:	COW-2A	COW-3 TOP	COW-3 BOTTOM
			Lab Code:	K0238-3	K0238-4	K0238-5
Arsenic	7060	1		1	1	1
Cadmium	7131	0.1		ND	ND	ND
Chromium	6010	1		5	6	6
Copper	6010	1		14	14	18
Lead	7421	1		ND	ND	ND
Mercury	7471	0.02		ND	ND	ND
Nickel	249.2	1		5	5	4
Silver	7761	0.1		ND	ND	ND
Zinc	6010	1		18	20	20
Solids, Total (%)	160.3	--		78.6	77.0	74.2

MRL Method Reporting Limit

ND None Detected at or above the method reporting limit

Approved by Dave Edelman Date 2/19/91

00001

**COLUMBIA ANALYTICAL SERVICES, INC.**

Analytical Report

**Client:** U.S. Army Corps of Engineers  
**Submitted By:** Mr. Jim Paxton  
**Project:** Mouth of Cowlitz  
**Sample Matrix:** Sediment

**Date Received:** 01/15/91  
**Work Order #:** K910238

Total Metals  
mg/Kg (ppm)  
Dry Weight Basis

Sample Name:			COW-2A	COW-3 TOP	COW-3 BOTTOM
Lab Code:			K0238-3	K0238-4	K0238-5
Analytes	Method	MRL			
Arsenic	7060	1	1	1	1
Cadmium	7131	0.1	ND	ND	ND
Chromium	6010	1	5	6	6
Copper	6010	1	14	14	18
Lead	7421	1	ND	ND	ND
Mercury	7471	0.02	ND	ND	ND
Nickel	249.2	1	5	5	4
Silver	7761	0.1	ND	ND	ND
Zinc	6010	1	18	20	20
Solids, Total (%)	160.3	--	78.6	77.0	74.2

**MRL** Method Reporting Limit

**ND** None Detected at or above the method reporting limit

Approved by Dave Edelman Date 2/19/91

00001

**COLUMBIA ANALYTICAL SERVICES, INC.**

**Analytical Report**

**Client:** U.S. Army Corps of Engineers  
**Submitted By:** Mr. Jim Paxton  
**Project:** Mouth of Cowlitz  
**Sample Matrix:** Sediment

**Date Received:** 01/15/91  
**Work Order #:** K910238

Total Metals  
mg/Kg (ppm)  
Dry Weight Basis

**Sample Name:**  
**Lab Code:**

**COW-4**  
**K0238-6**

**Method Blank**  
**K0238-MB**

Analytes	Method	MRL		
Arsenic	7060	1	2	ND
Cadmium	7131	0.1	ND	ND
Chromium	6010	1	8	ND
Copper	6010	1	5	ND
Lead	7421	1	2	ND
Mercury	7471	0.02	ND	ND
Nickel	249.2	1	7	ND
Silver	7761	0.1	ND	ND
Zinc	6010	1	28	ND
Solids, Total (%)	160.3	--	79.0	ND

**MRL** Method Reporting Limit  
**ND** None Detected at or above the method reporting limit

Approved by Dave Edelman Date \_\_\_\_\_

00002

**COLUMBIA ANALYTICAL SERVICES, INC.**

**Analytical Report**

**Client:** U.S. Army Corps of Engineers  
**Submitted By:** Mr. Jim Paxton  
**Project:** Mouth of Cowlitz  
**Sample Matrix:** Sediment

**Date Received:** 01/15/91  
**Work Order #:** K910238

Total Metals  
mg/Kg (ppm)  
Dry Weight Basis

**Sample Name:**  
**Lab Code:**

**COW-4**  
**K0238-6**

**Method Blank**  
**K0238-MB**

<b>Analytes</b>	<b>Method</b>	<b>MRL</b>		
Arsenic	7060	1	2	ND
Cadmium	7131	0.1	ND	ND
Chromium	6010	1	8	ND
Copper	6010	1	5	ND
Lead	7421	1	2	ND
Mercury	7471	0.02	ND	ND
Nickel	249.2	1	7	ND
Silver	7761	0.1	ND	ND
Zinc	6010	1	28	ND
Solids, Total (%)	160.3	--	79.0	ND

**MRL** Method Reporting Limit  
**ND** None Detected at or above the method reporting limit

Approved by Dave Edelman Date \_\_\_\_\_

00002

**COLUMBIA ANALYTICAL SERVICES, INC.**

**Analytical Report**

**Client:** U.S. Army Corps of Engineers  
**Submitted By:** Mr. Jim Paxton  
**Project:** Mouth of Cowlitz  
**Sample Matrix:** Sediment

**Date Received:** 01/15/91  
**Date Extracted:** 01/24/91  
**Date Analyzed:** 01/31/91  
**Work Order #:** K910238

Polynuclear Aromatic Hydrocarbons and Phenols  
 EPA Methods 3540/Modified 8270  
 mg/Kg (ppm)  
 Dry Weight Basis

Sample Name: Lab Code:		COW-2A K0238-3	COW-3 TOP K0238-4	COW-3 BOTTOM K0238-5
Analytes	MRL			
Naphthalene	0.02	ND	ND	ND
2-Methylnaphthalene	0.02	ND	ND	ND
Acenaphthylene	0.02	ND	ND	ND
Dibenzofuran	0.02	ND	ND	ND
Nacenaphthene	0.02	ND	ND	ND
Fluorene	0.02	ND	ND	ND
Phenanthrene	0.02	ND	ND	ND
Anthracene	0.02	ND	ND	ND
Fluoranthene	0.02	ND	ND	ND
Pyrene	0.02	ND	ND	ND
Benzo(a)anthracene	0.02	ND	ND	ND
Chrysene	0.02	ND	ND	ND
Benzo(b+k)fluoranthene	0.04	ND	ND	ND
Benzo(a)pyrene	0.02	ND	ND	ND
Indeno(1,2,3-cd)pyrene	0.02	ND	ND	ND
Dibenzo(a,h)anthracene	0.02	ND	ND	ND
Benzo(g,h,i)perylene	0.02	ND	ND	ND
Phenol	0.02	ND	ND	ND
2-Methylphenol	0.02	ND	ND	ND
4-Methylphenol	0.02	ND	ND	ND
2,4-Dimethylphenol	0.02	ND	ND	ND
Pentachlorophenol	0.05	ND	ND	ND

**MRL** Method Reporting Limit

**ND** None Detected at or above the method reporting limit

Approved by Dave Edelmann Date 2/19/91

00003

**COLUMBIA ANALYTICAL SERVICES, INC.**

**Analytical Report**

**Client:** U.S. Army Corps of Engineers  
**Submitted By:** Mr. Jim Paxton  
**Project:** Mouth of Cowlitz  
**Sample Matrix:** Sediment

**Date Received:** 01/15/91  
**Date Extracted:** 01/24/91  
**Date Analyzed:** 01/31/91  
**Work Order #:** K910238

Polynuclear Aromatic Hydrocarbons and Phenols  
 EPA Methods 3540/Modified 8270  
 mg/Kg (ppm)  
 Dry Weight Basis

Sample Name: Lab Code:		COW-2A K0238-3	COW-3 TOP K0238-4	COW-3 BOTTOM K0238-5
Analytes	MRL			
Naphthalene	0.02	ND	ND	ND
2-Methylnaphthalene	0.02	ND	ND	ND
Acenaphthylene	0.02	ND	ND	ND
Dibenzofuran	0.02	ND	ND	ND
Nacenaphthene	0.02	ND	ND	ND
Fluorene	0.02	ND	ND	ND
Phenanthrene	0.02	ND	ND	ND
Anthracene	0.02	ND	ND	ND
Fluoranthene	0.02	ND	ND	ND
Pyrene	0.02	ND	ND	ND
Benzo(a)anthracene	0.02	ND	ND	ND
Chrysene	0.02	ND	ND	ND
Benzo(b+k)fluoranthene	0.04	ND	ND	ND
Benzo(a)pyrene	0.02	ND	ND	ND
Indeno(1,2,3-cd)pyrene	0.02	ND	ND	ND
Dibenzo(a,h)anthracene	0.02	ND	ND	ND
Benzo(g,h,i)perylene	0.02	ND	ND	ND
Phenol	0.02	ND	ND	ND
2-Methylphenol	0.02	ND	ND	ND
4-Methylphenol	0.02	ND	ND	ND
2,4-Dimethylphenol	0.02	ND	ND	ND
Pentachlorophenol	0.05	ND	ND	ND

**MRL** Method Reporting Limit

**ND** None Detected at or above the method reporting limit

Approved by Dave Edelmann Date 2/19/91

00003

**COLUMBIA ANALYTICAL SERVICES, INC.**

**Analytical Report**

**Client:** U.S. Army Corps of Engineers  
**Submitted By:** Mr. Jim Paxton  
**Project:** Mouth of Cowlitz  
**Sample Matrix:** Sediment

**Date Received:** 01/15/91  
**Date Extracted:** 01/24/91  
**Date Analyzed:** 01/31/91  
**Work Order #:** K910238

Polynuclear Aromatic Hydrocarbons and Phenols  
 EPA Methods 3540/Modified 8270  
 mg/Kg (ppm)  
 Dry Weight Basis

**Sample Name:**  
**Lab Code:**

**COW-4**  
**K0238-6**

**Method Blank**  
**K0238-MB**

<b>Analytes</b>	<b>MRL</b>		
Naphthalene	0.02	ND	ND
2-Methylnaphthalene	0.02	ND	ND
Acenaphthylene	0.02	ND	ND
Dibenzofuran	0.02	ND	ND
Nacenaphthene	0.02	ND	ND
Fluorene	0.02	ND	ND
Phenanthrene	0.02	ND	ND
Anthracene	0.02	ND	ND
Fluoranthene	0.02	ND	ND
Pyrene	0.02	ND	ND
Benzo(a)anthracene	0.02	ND	ND
Chrysene	0.02	ND	ND
Benzo(b+k)fluoranthene	0.04	ND	ND
Benzo(a)pyrene	0.02	ND	ND
Indeno(1,2,3-cd)pyrene	0.02	ND	ND
Dibenzo(a,h)anthracene	0.02	ND	ND
Benzo(g,h,i)perylene	0.02	ND	ND
Phenol	0.02	ND	ND
2-Methylphenol	0.02	ND	ND
4-Methylphenol	0.02	ND	ND
2,4-Dimethylphenol	0.02	ND	ND
Pentachlorophenol	0.05	ND	ND

**MRL** Method Reporting Limit

**ND** None Detected at or above the method reporting limit

Approved by Dave Edelson Date 2/19/91

00004

**COLUMBIA ANALYTICAL SERVICES, INC.**

**Analytical Report**

**Client:** U.S. Army Corps of Engineers  
**Submitted By:** Mr. Jim Paxton  
**Project:** Mouth of Cowlitz  
**Sample Matrix:** Sediment

**Date Received:** 01/15/91  
**Date Extracted:** 01/24/91  
**Date Analyzed:** 01/31/91  
**Work Order #:** K910238

Polynuclear Aromatic Hydrocarbons and Phenols  
 EPA Methods 3540/Modified 8270  
 mg/Kg (ppm)  
 Dry Weight Basis

**Sample Name:**  
**Lab Code:**

**COW-4**  
**K0238-6**

**Method Blank**  
**K0238-MB**

Analytes	MRL		
Naphthalene	0.02	ND	ND
2-Methylnaphthalene	0.02	ND	ND
Acenaphthylene	0.02	ND	ND
Dibenzofuran	0.02	ND	ND
Nacenaphthene	0.02	ND	ND
Fluorene	0.02	ND	ND
Phenanthrene	0.02	ND	ND
Anthracene	0.02	ND	ND
Fluoranthene	0.02	ND	ND
Pyrene	0.02	ND	ND
Benzo(a)anthracene	0.02	ND	ND
Chrysene	0.02	ND	ND
Benzo(b+k)fluoranthene	0.04	ND	ND
Benzo(a)pyrene	0.02	ND	ND
Indeno(1,2,3-cd)pyrene	0.02	ND	ND
Dibenzo(a,h)anthracene	0.02	ND	ND
Benzo(g,h,i)perylene	0.02	ND	ND
Phenol	0.02	ND	ND
2-Methylphenol	0.02	ND	ND
4-Methylphenol	0.02	ND	ND
2,4-Dimethylphenol	0.02	ND	ND
Pentachlorophenol	0.05	ND	ND

**MRL** Method Reporting Limit

**ND** None Detected at or above the method reporting limit

Approved by Dave Edelson Date 2/19/91

00004

## COLUMBIA ANALYTICAL SERVICES, INC.

## Analytical Report

Client: U.S. Army Corps of Engineers  
 Submitted By: Mr. Jim Paxton  
 Project: Mouth of Cowlitz  
 Sample Matrix: Sediment

Date Received: 01/15/91  
 Date Extracted: 01/22/91  
 Date Analyzed: 01/25/91  
 Work Order #: K910238

Organochlorine Pesticides and PCBs  
 EPA Methods 3540/8080  
 mg/Kg (ppm)  
 Dry Weight Basis

Sample Name: Lab Code:		COW-2A K0238-3	COW-3 TOP K0238-4	COW-3 BOTTOM K0238-5
Analytes	MRL			
Alpha-BHC	0.001	ND	ND	ND
Gamma-BHC (Lindane)	0.001	ND	ND	ND
Beta-BHC	0.003	ND	ND	ND
Heptachlor	0.001	ND	ND	ND
Delta-BHC	0.001	ND	ND	ND
Aldrin	0.001	ND	ND	ND
Heptachlor Epoxide	0.001	ND	ND	ND
Endosulfan I	0.001	ND	ND	ND
4,4'-DDE	0.001	ND	ND	ND
Dieldrin	0.001	ND	ND	ND
Endrin	0.001	ND	ND	ND
4,4'-DDD	0.001	ND	ND	ND
Endosulfan II	0.001	ND	ND	ND
4,4'-DDT	0.001	ND	ND	ND
Endrin Aldehyde	0.001	ND	ND	ND
Endosulfan Sulfate	0.001	ND	ND	ND
Methoxychlor	0.002	ND	ND	ND
Toxaphene	0.03	ND	ND	ND
Chlordane	0.01	ND	ND	ND
PCBs: Aroclor 1016	0.01	ND	ND	ND
Aroclor 1221	0.01	ND	ND	ND
Aroclor 1232	0.01	ND	ND	ND
Aroclor 1242	0.01	ND	ND	ND
Aroclor 1248	0.01	ND	ND	ND
Aroclor 1254	0.01	ND	ND	ND
Aroclor 1260	0.01	ND	ND	ND

MRL Method Reporting Limit  
 ND None Detected at or above the method reporting limit

Approved by Dave Schuman Date 2/19/91

00005

## COLUMBIA ANALYTICAL SERVICES, INC.

## Analytical Report

Client: U.S. Army Corps of Engineers  
 Submitted By: Mr. Jim Paxton  
 Project: Mouth of Cowlitz  
 Sample Matrix: Sediment

Date Received: 01/15/91  
 Date Extracted: 01/22/91  
 Date Analyzed: 01/25/91  
 Work Order #: K910238

Organochlorine Pesticides and PCBs  
 EPA Methods 3540/8080  
 mg/Kg (ppm)  
 Dry Weight Basis

Sample Name: Lab Code:		COW-2A K0238-3	COW-3 TOP K0238-4	COW-3 BOTTOM K0238-5
Analytes	MRL			
Alpha-BHC	0.001	ND	ND	ND
Gamma-BHC (Lindane)	0.001	ND	ND	ND
Beta-BHC	0.003	ND	ND	ND
Heptachlor	0.001	ND	ND	ND
Delta-BHC	0.001	ND	ND	ND
Aldrin	0.001	ND	ND	ND
Heptachlor Epoxide	0.001	ND	ND	ND
Endosulfan I	0.001	ND	ND	ND
4,4'-DDE	0.001	ND	ND	ND
Dieldrin	0.001	ND	ND	ND
Endrin	0.001	ND	ND	ND
4,4'-DDD	0.001	ND	ND	ND
Endosulfan II	0.001	ND	ND	ND
4,4'-DDT	0.001	ND	ND	ND
Endrin Aldehyde	0.001	ND	ND	ND
Endosulfan Sulfate	0.001	ND	ND	ND
Methoxychlor	0.002	ND	ND	ND
Toxaphene	0.03	ND	ND	ND
Chlordane	0.01	ND	ND	ND
PCBs: Aroclor 1016	0.01	ND	ND	ND
Aroclor 1221	0.01	ND	ND	ND
Aroclor 1232	0.01	ND	ND	ND
Aroclor 1242	0.01	ND	ND	ND
Aroclor 1248	0.01	ND	ND	ND
Aroclor 1254	0.01	ND	ND	ND
Aroclor 1260	0.01	ND	ND	ND

MRL Method Reporting Limit  
 ND None Detected at or above the method reporting limit

Approved by Dave Edelman Date 2/19/91

00005

## COLUMBIA ANALYTICAL SERVICES, INC.

## Analytical Report

Client: U.S. Army Corps of Engineers  
 Submitted By: Mr. Jim Paxton  
 Project: Mouth of Cowlitz  
 Sample Matrix: Sediment

Date Received: 01/15/91  
 Date Extracted: 01/22/91  
 Date Analyzed: 01/25/91  
 Work Order #: K910238

Organochlorine Pesticides and PCBs  
 EPA Methods 3540/8080  
 mg/Kg (ppm)  
 Dry Weight Basis

Sample Name: Lab Code:		COW-4 K0238-6	Method Blank K0238-MB
Analytes	MRL		
Alpha-BHC	0.001	ND	ND
Gamma-BHC (Lindane)	0.001	ND	ND
Beta-BHC	0.003	ND	ND
Heptachlor	0.001	ND	ND
Delta-BHC	0.001	ND	ND
Aldrin	0.001	ND	ND
Heptachlor Epoxide	0.001	ND	ND
Endosulfan I	0.001	ND	ND
4,4'-DDE	0.001	ND	ND
Dieldrin	0.001	ND	ND
Endrin	0.001	ND	ND
4,4'-DDD	0.001	ND	ND
Endosulfan II	0.001	ND	ND
4,4'-DDT	0.001	ND	ND
Endrin Aldehyde	0.001	ND	ND
Endosulfan Sulfate	0.001	ND	ND
Methoxychlor	0.002	ND	ND
Toxaphene	0.03	ND	ND
Chlordane	0.01	ND	ND
PCBs:Aroclor 1016	0.01	ND	ND
Aroclor 1221	0.01	ND	ND
Aroclor 1232	0.01	ND	ND
Aroclor 1242	0.01	ND	ND
Aroclor 1248	0.01	ND	ND
Aroclor 1254	0.01	ND	ND
Aroclor 1260	0.01	ND	ND

MRL Method Reporting Limit  
 ND None Detected at or above the method reporting limit

Approved by Dave Edelman Date 2/19/91

## COLUMBIA ANALYTICAL SERVICES, INC.

## Analytical Report

Client: U.S. Army Corps of Engineers  
 Submitted By: Mr. Jim Paxton  
 Project: Mouth of Cowlitz  
 Sample Matrix: Sediment

Date Received: 01/15/91  
 Date Extracted: 01/22/91  
 Date Analyzed: 01/25/91  
 Work Order #: K910238

Organochlorine Pesticides and PCBs  
 EPA Methods 3540/8080  
 mg/Kg (ppm)  
 Dry Weight Basis

Sample Name:  
 Lab Code:

COW-4  
 K0238-6

Method Blank  
 K0238-MB

Analytes	MRL		
Alpha-BHC	0.001	ND	ND
Gamma-BHC (Lindane)	0.001	ND	ND
Beta-BHC	0.003	ND	ND
Heptachlor	0.001	ND	ND
Delta-BHC	0.001	ND	ND
Aldrin	0.001	ND	ND
Heptachlor Epoxide	0.001	ND	ND
Endosulfan I	0.001	ND	ND
4,4'-DDE	0.001	ND	ND
Dieldrin	0.001	ND	ND
Endrin	0.001	ND	ND
4,4'-DDD	0.001	ND	ND
Endosulfan II	0.001	ND	ND
4,4'-DDT	0.001	ND	ND
Endrin Aldehyde	0.001	ND	ND
Endosulfan Sulfate	0.001	ND	ND
Methoxychlor	0.002	ND	ND
Toxaphene	0.03	ND	ND
Chlordane	0.01	ND	ND
PCBs:Aroclor 1016	0.01	ND	ND
Aroclor 1221	0.01	ND	ND
Aroclor 1232	0.01	ND	ND
Aroclor 1242	0.01	ND	ND
Aroclor 1248	0.01	ND	ND
Aroclor 1254	0.01	ND	ND
Aroclor 1260	0.01	ND	ND

MRL Method Reporting Limit  
 ND None Detected at or above the method reporting limit

Approved by Dave Edelman Date 2/19/91

**APPENDIX A**  
**LABORATORY QC RESULTS**

**COLUMBIA ANALYTICAL SERVICES, INC.**

**Client:** U.S. Army Corps of Engineers  
**Submitted By:** Mr. Jim Paxton  
**Project:** Mouth of Cowlitz  
**Sample Matrix:** Sediment

**Date Received:** 01/15/91  
**Work Order #:** K910238

QA/QC Report  
Duplicate Summary  
Total Metals  
mg/Kg (ppm)  
Dry Weight Basis

**Sample Name:** COW-3 TOP  
**Lab Code:** K0238-4

Analytes	Method	MRL	Sample Result	Duplicate Sample Result	Average	Relative Percent Difference
Arsenic	7060	1	1	2	2	50
Cadmium	7131	0.1	ND	ND	ND	-
Chromium	6010	1	6	6	6	<1
Copper	6010	1	14	16	15	13
Lead	7421	1	ND	ND	ND	-
Mercury	7471	0.02	ND	ND	ND	-
Nickel	249.2	1	5	5	5	<1
Silver	7761	0.1	ND	ND	ND	-
Zinc	6010	1	20	21	20	5

**MRL** Method Reporting Limit

**ND** None Detected at or above the method reporting limit

Approved by Dave Eshelmann Date 2/19/91

00008

**COLUMBIA ANALYTICAL SERVICES, INC.**

**Client:** U.S. Army Corps of Engineers  
**Submitted By:** Mr. Jim Paxton  
**Project:** Mouth of Cowlitz  
**Sample Matrix:** Sediment

**Date Received:** 01/15/91  
**Work Order #:** K910238

QA/QC Report  
Duplicate Summary  
Total Metals  
mg/Kg (ppm)  
Dry Weight Basis

**Sample Name:** COW-3 TOP  
**Lab Code:** K0238-4

Analytes	Method	MRL	Sample Result	Duplicate Sample Result	Average	Relative Percent Difference
Arsenic	7060	1	1	2	2	50
Cadmium	7131	0.1	ND	ND	ND	--
Chromium	6010	1	6	6	6	<1
Copper	6010	1	14	16	15	13
Lead	7421	1	ND	ND	ND	--
Mercury	7471	0.02	ND	ND	ND	--
Nickel	249.2	1	5	5	5	<1
Silver	7761	0.1	ND	ND	ND	--
Zinc	6010	1	20	21	20	5

**MRL** Method Reporting Limit

**ND** None Detected at or above the method reporting limit

Approved by Dave Egleman Date 2/19/91

00008

**COLUMBIA ANALYTICAL SERVICES, INC.**

**Client:** U.S. Army Corps of Engineers  
**Submitted By:** Mr. Jim Paxton  
**Project:** Mouth of Cowlitz  
**Sample Matrix:** Sediment

**Date Received:** 01/15/91  
**Work Order #:** K910238

QA/QC Report  
 Matrix Spike Summary  
 Total Metals  
 mg/Kg (ppm)  
 Dry Weight Basis

**Sample Name:** COW-3 TOP  
**Lab Code:** K0238-4MS

Analytes	MRL	Spike Level	Sample Result	Spiked Sample Result	Percent Recovery
Arsenic	1	10	1	11	100
Cadmium	0.1	10.4	ND	9.7	93
Chromium	1	52	6	54	92
Copper	1	65	14	77	97
Lead	1	5	ND	6	120
Mercury	0.02	0.09	ND	0.08	89
Nickel	1	6	5	10	83
Silver	0.1	1.3	ND	1.1	85
Zinc	1	130	20	137	90

**MRL** Method Reporting Limit  
**ND** None Detected at or above the method reporting limit

Approved by Dave Edelmann Date 2/19/91

00009

**COLUMBIA ANALYTICAL SERVICES, INC.**

**Client:** U.S. Army Corps of Engineers  
**Submitted By:** Mr. Jim Paxton  
**Project:** Mouth of Cowlitz  
**Sample Matrix:** Sediment

**Date Received:** 01/15/91  
**Work Order #:** K910238

QA/QC Report  
 Matrix Spike Summary  
 Total Metals  
 mg/Kg (ppm)  
 Dry Weight Basis

**Sample Name:** COW-3 TOP  
**Lab Code:** K0238-4MS

Analytes	MRL	Spike Level	Sample Result	Spiked Sample Result	Percent Recovery
Arsenic	1	10	1	11	100
Cadmium	0.1	10.4	ND	9.7	93
Chromium	1	52	6	54	92
Copper	1	65	14	77	97
Lead	1	5	ND	6	120
Mercury	0.02	0.09	ND	0.08	89
Nickel	1	6	5	10	83
Silver	0.1	1.3	ND	1.1	85
Zinc	1	130	20	137	90

**MRL** Method Reporting Limit  
**ND** None Detected at or above the method reporting limit

Approved by Dave Edelmann Date 2/19/91

00009

COLUMBIA ANALYTICAL SERVICES, INC.

Client: U.S. Army Corps of Engineers  
Submitted By: Mr. Jim Paxton  
Project: Mouth of Cowlitz  
Sample Matrix: Sediment

Date Received: 01/15/91  
Date Extracted: 01/24/91  
Date Analyzed: 01/31/91  
Work Order #: K910238

QA/QC Report  
Surrogate Recovery Summary  
Polynuclear Aromatic Hydrocarbons and Phenols  
EPA Methods 3540/Modified 8270

Sample Name	Lab Code	P e r c e n t R e c o v e r y		
		Naphthalene - D <sub>8</sub>	Fluorene - D <sub>10</sub>	Chrysene - D <sub>12</sub>
COW-2A	K0238-3	47.4	65.9	46.7
COW-3 TOP	K0238-4	64.9	83.8	50.2
COW-3 BOTTOM	K0238-5	63.9	79.0	52.7
COW-4	K0238-6	61.8	76.0	51.0
Method Blank	K0238-MB	44.0	49.6	43.2

Approved by Dave Edelmann Date 2/19/91

00010

COLUMBIA ANALYTICAL SERVICES, INC.

Client: U.S. Army Corps of Engineers  
Submitted By: Mr. Jim Paxton  
Project: Mouth of Cowlitz  
Sample Matrix: Sediment

Date Received: 01/15/91  
Date Extracted: 01/24/91  
Date Analyzed: 01/31/91  
Work Order #: K910238

QA/QC Report  
Surrogate Recovery Summary  
Polynuclear Aromatic Hydrocarbons and Phenols  
EPA Methods 3540/Modified 8270

Sample Name	Lab Code	P e r c e n t R e c o v e r y		
		Naphthalene - D <sub>8</sub>	Fluorene - D <sub>10</sub>	Chrysene - D <sub>12</sub>
COW-2A	K0238-3	47.4	65.9	46.7
COW-3 TOP	K0238-4	64.9	83.8	50.2
COW-3 BOTTOM	K0238-5	63.9	79.0	52.7
COW-4	K0238-6	61.8	76.0	51.0
Method Blank	K0238-MB	44.0	49.6	43.2

Approved by Dave Edelmann Date 2/19/91

00010

COLUMBIA ANALYTICAL SERVICES, INC.

Client: U.S. Army Corps of Engineers  
Submitted By: Mr. Jim Paxton  
Project: Mouth of Cowlitz  
Sample Matrix: Sediment

Date Received: 01/15/91  
Date Extracted: 01/22/91  
Date Analyzed: 01/25/91  
Work Order #: K910238

QA/QC Report  
Surrogate Recovery Summary  
Organochlorine Pesticides and PCBs  
EPA Methods 3540/8080

Sample Name	Lab Code	Percent Recovery	
		Tetrachloro- <i>m</i> -xylene	Decachlorobiphenyl
COW-2A	K0238-3	81.3	84.1
COW-3 TOP	K0238-4	86.5	90.1
COW-3 TOP	K0238-4MS	84.9	91.3
COW-3 TOP	K0238-4DMS	90.9	96.8
COW-3 BOTTOM	K0238-5	86.1	87.7
COW-4	K0238-6	92.4	103
Method Blank	K0238-MB	106	113

CAS Acceptance Criteria	20-150	65-130
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Approved by Dave Edelmann Date 2/14/91

00011

COLUMBIA ANALYTICAL SERVICES, INC.

Client: U.S. Army Corps of Engineers  
Submitted By: Mr. Jim Paxton  
Project: Mouth of Cowlitz  
Sample Matrix: Sediment

Date Received: 01/15/91  
Date Extracted: 01/22/91  
Date Analyzed: 01/25/91  
Work Order #: K910238

QA/QC Report  
Surrogate Recovery Summary  
Organochlorine Pesticides and PCBs  
EPA Methods 3540/8080

Sample Name	Lab Code	Percent Recovery	
		Tetrachloro- <i>m</i> -xylene	Decachlorobiphenyl
COW-2A	K0238-3	81.3	84.1
COW-3 TOP	K0238-4	86.5	90.1
COW-3 TOP	K0238-4MS	84.9	91.3
COW-3 TOP	K0238-4DMS	90.9	96.8
COW-3 BOTTOM	K0238-5	86.1	87.7
COW-4	K0238-6	92.4	103
Method Blank	K0238-MB	106	113

CAS Acceptance Criteria	20-150	65-130
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Approved by Dave Edelman Date 2/14/91

00011

**COLUMBIA ANALYTICAL SERVICES, INC.**

**Client:** U.S. Army Corps of Engineers  
**Submitted By:** Mr. Jim Paxton  
**Project:** Mouth of Cowlitz  
**Sample Matrix:** Sediment

**Date Received:** 01/15/91  
**Date Extracted:** 01/22/91  
**Date Analyzed:** 01/25/91  
**Work Order #:** K910238

QA/QC Report  
 Matrix Spike/Duplicate Matrix Spike Summary  
 Organochlorine Pesticides and PCBs  
 EPA Methods 3540/8080  
 mg/Kg (ppm)  
 Dry Weight Basis

**Sample Name:** COW-3 TOP  
**Lab Code:** K0238-4MS/DMS

**Percent Recovery**

Analytes	Spike Level		Sample Result	Spike Result		Percent Recovery		EPA Acceptance Criteria
	MS	DMS		MS	DMS	MS	DMS	
Gamma-BHC (Lindane)	0.044	0.045	ND	0.049	0.057	111	127	46-127
Heptachlor	0.044	0.045	ND	0.052	0.061	118	*136	35-120
Aldrin	0.044	0.045	ND	0.046	0.057	105	127	34-132
Dieldrin	0.044	0.045	ND	0.056	0.062	127	*138	31-134
Endrin	0.044	0.045	ND	0.056	0.062	127	138	42-139
4,4'-DDT	0.044	0.045	ND	0.059	0.063	134	*140	23-134

**ND** None Detected at or above the method reporting limit

**\*** Outside acceptance limits. Since no target analytes were detected in the sample, the elevated percent recovery does not adversely impact the data.

Approved by Dave Edelman Date 2/19/91

00012